



A fusible conductor assembly 20 extends through cavity 14 of fuse casing 12, as best seen in FIG. 2. The fusible conductor assembly 20 in and of itself forms no part of the present invention, and therefore shall not be described in great detail. Basically, fusible conductor assembly 20 is comprised of a conductive element 22 that is formed of a flat strip of conductive material, preferably formed of silver, copper or copper alloys. The dimensions of conductive element 22 determine the Ampere rating of fuse 10. (In this respect, the present invention finds advantageous application for fuses rated from 6 to 6,000 amps). In the embodiment shown, conductive element 22 includes a plurality of aligned apertures 24 that define a plurality of "notched sections" 26 that reduce the cross-section of conductive element 22 and establish the current carrying capacity thereof. Conductive element 22 includes elongated ends or tabs 28 that are adapted to be bent around the ends of fuse casing 12, as best seen in FIGS. 2 and 3. Fusible conductor assembly 20 has a predetermined current carrying capacity and has a specific resistance.

An indicator component 40 is provided along the exterior of fuse casing 12, as best seen in FIGS. 910 and 1011. (In the drawings, the thickness of indicator component 40, and the components forming indicator component 40, are exaggerated for the purpose of illustration). In the embodiment shown, indicator component 40 is shaped as a long, narrow strip that extends essentially from one end of fuse casing 12 to the other end.

Indicator component 40, best seen in FIGS. 910 and 1011, is basically a layered structure comprised of an indicator layer 42 and an electrically conductive layer 44. Indicator layer 42 may be formed from a variety of non-conductive, non-flammable materials including certain papers and plastics that are treated with a flame retardant material to render them non-flammable. In a preferred embodiment of the

present invention, indicator layer 42 is comprised of a polymeric film that is deep-dyed of a bright color. In a preferred embodiment, indicator layer 42 is a red, Mylar® film having a thickness of about .002 inches. A clear polymer film having dyed adhesive material therebelow may also find advantageous application in the present invention.

Electrically conductive layer 44 is preferably formed of at least one layer of a metal. Electrically conductive layer 44 may be formed of a variety of different metals, such as, by way of example and not limitation, copper, zinc, aluminum and nichrome. As used herein, the term "conductive layer 44" also includes a multi-layered structure comprised of two or more layers of different metals, such as, for example, a nickel-on-aluminum conductive layer 44 or copper on aluminum conductive layer 44. In the embodiment shown, conductive layer 44 is formed of aluminum. Electrically conductive layer 44 is preferably deposited onto indicator layer 42 by conventional metallization processes, such as vacuum metallization or metal sputtering techniques.

In the embodiment shown, electrically conductive layer 44 is vapor deposited onto colored indicator layer 42. The thickness and cross-sectional area of electrically conductive layer 44 is based upon the size of fuse 10. In other words, the cross-sectional area of electrically conductive layer 44 is established such that electrically conductive layer 44 has a specific resistance and current carrying capacity in relation to the resistance and current carrying capacity of fusible conductor assembly 20. Specifically, electrically conductive layer 44 is dimensioned to have a higher resistance than the resistance of fusible conductor assembly 20. In the embodiment shown, for a 30 Ampere fuse, electrically conductive layer 44 basically has a resistance of about 4 ohms ( $\Omega$ ) and a current carrying capacity of about 6 Amperes.

Electrically conductive layer 44 preferably has a width of about .25 inches, and a thickness of about 3,000Å.

Electrically conductive layer 44 is designed to have a region 44a of increased electrical resistance. In the embodiment shown, region 44a has a reduced, cross-sectional area, so as to increase the electrical resistance of electrically conductive layer 44 within region 44a. Region 44a may be formed by reducing the width, thickness or metallic composition of conductive layer 44 in a direction perpendicular to the direction of current flow. In the embodiment shown, region 44a of reduced, cross-sectional area is formed by reducing the thickness of electrically conductive layer 44 along a portion thereof, as best seen in FIG. 1011. The reduced thickness in region 44a creates a cavity or depression in electrically conductive layer 44, as also seen in FIGS. 10 and 11.

Indicator component 40 is dimensioned to extend along the outer surface of fuse casing 12. An adhesive layer, designated 46 in the drawings (see for example, FIG. 4) may be used during assembly to mount indicator component 40 to fuse casing 12, as shall be described in greater detail below. Adhesive layer 46 may be any type of adhesive, but is preferably a pressure-sensitive adhesive for easy attachment of indicator component 40 to fuse casing 12. As indicated above, adhesive layer 46 may be dyed to provide color beneath a clear polymer film as part of indicator layer 42.

Inner rings 52, seen in FIGS. 2-5, formed of metal are attached to the distal ends of fuse casing 12. Inner rings 52 are dimensioned to overlay, and be in contact with, a portion of electrically conductive layer 44 (see FIG. 14). Inner rings 52 are rolled, crimped or press fit onto the ends of fuse casing 12 wherein the inner surface of each inner ring 52 is in electrically conductive contact with one end of electrically conductive layer 44 of indicator component 40.

layer 44 will vary depending upon how much the current density (J) applied to conductive layer 44 exceeds the critical current density ( $J_{critical}$ ) for that conductive layer 44.

Another factor that affects the disintegration of conductive layer 44 is the voltage ( $V_{critical}$ ) needed to produce the critical current density ( $J_{critical}$ ). In this respect,

$$V_{critical} = J_{critical} \cdot \rho \cdot L,$$

where " $\rho$ " is the resistivity of the metal that forms conductive layer 44, and "L" is the length of conductive layer 44. As will be appreciated, varying the dimensions and composition of conductive layer 44 will vary " $\rho$ " and "L," thus changing  $V_{critical}$  and

$J_{critical}$ . Accordingly, indicators responsive to various operating conditions may be designed by varying the composition and shape of conductive layer 44.

The foregoing description describes specific embodiments of the present invention. Numerous alterations and modifications will occur to those skilled in the art.

Referring now to FIGS. 13 through 16, alternate embodiments of the present invention are shown. Specifically, FIGS. 13 and 14 show an indicator component 40, in accordance with the present invention, used in fuse 210 having blade contacts 212, as contrasted to end ferrules 82, shown in FIGS. 1 through 12. In this respect, unlike the embodiment shown in FIGS. 1 through 12, wherein electrically conductive layer 44 of indicator component 40 comes in contact with conductive end ferrules 82 through metallic inner rings 52, eyelets 214 and pins 216 extending through the ends of indicator component 40 are provided in fuse 210 to form a current path through indicator component 40 to internal metal blocks 222 that are attached to conductive blade contacts 212. The embodiments shown in FIGS. ~~12~~13 through ~~15~~16 show how

